

AbstractID: 7317 Title: An efficient deformable volume rendering on modern PC graphics hardware

**Purpose:** Direct volume rendering (DVR) is a common medical image visualization technique that provides better anatomy or object perception in three dimensional space than typical three orthogonal sectional images. In this study we present a fast and efficient deformable DVR method, implemented on modern consumer grade PC graphics hardware, which will be useful for intensity-based deformable 3D/2D registrations as well as for deforming volume visualization during 3D/3D registrations.

**Method and Materials:** The method consists of three steps: (1) a cubical grid is defined on the input volume; (2) the grid is deformed using global or local radial basis functions such as thin plate splines; and then (3) the volume is texture-mapped to the deformed grid and projected to a predefined 2D pixel buffer. During projection, pixel intensities are scaled and accumulated using either *attenuate* or *over* blending operation. To minimize the intensity depth loss during the accumulation process, the pixel intensities are accumulated in a hidden pixel buffer, known as *pbuffer* in OpenGL. In our implementation we used 16 bit floating *pbuffer* instead of the standard 32 bit floating format because most graphics hardware did not support direct accumulation onto 32 bit floating buffers at the time of experiment. The accumulated intensity values are scaled to the valid display range [0,1].

**Results:** We were able to render a 256x256x256 anthropomorphic chest phantom CT image onto 512x512 render buffer with 20x20x20 grid at the speed of about 3 frames per second. The computer was equipped with a 1.8 GHz CPU, 512MB memory, 4x AGP, and an NVidia GeForce 6800 graphics adaptor.

**Conclusion:** Deformable DVR on modern PC graphics hardware is efficient in terms of speed and quality. This method may be useful for deformable 3D/2D image registrations and visualization for 3D/3D image registrations.